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ABSTRACT

An 8-week summer institute for 32 secondary school teachers from New Hampshire and nearby states was designed to show them the activities of chemists in research and in manufacturing. Intentions were to improve their teaching skills by showing them how the chemistry that they are teaching is used in practice, thus enabling them to improve their teaching effectiveness and their competence in guidance. The program was centered on weekly trips tc research laboratories and manufacturing plants. Lecture and laboratory work on the campus were directly related to the trips. The activities of chemists were further exemplified by guest lecturers, work with modern laboratory instruments, and an introduction to computers. At the end of a year of teaching, following the institute, the participants were unanimously enthusiastic about the impact of the program on their teaching. (The report focuses on changes which would be made if the institute were run again. Publicity materials and lists of visiting lectures, tours, and consultants are included.) (Author/JS)

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Director's Report

Summer Institute in Chemistry

Jan. 1, 1969 to June 30, 1970

Director: Roy H. Upham, Professor

St. Anselm's College

Manchester, N.H. 03102

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I. INTRODUCTION

The program was designed to better inform secondary school personnel about the activities of scientists in research and manufacturing. This was intended to improve both his knowledge and his enthusiasm in teaching and guiding his students. The students should find their courses more interesting and stimulating. This should motivate the students to better performance in the course and toward seeking careers in science.

II. OPERATION OF THE PROGRAM

1. Planning

The planning phase was conducted as described in the plan of operation.

The instructional staff was as listed in the Plan of Operation. The list of visiting lecturers was revised to better correlate with the planned tours. The lecturers, and their topics are listed in Appendix A.

The list of tours was revised by eliminating Brown, Co. and Dewey and Almy and substituting Yankee Atomic Electric Co. and Nashua Corporation. We had also considered several other possibilities. In all we investigated about twenty plants and laboratories. Most of these plants were visited by the staff and the ones that we toured were visited three to six times each. A list of the tours is given in appendix B.

Appendix C gives a partial list of the consultants who assisted us by explaining the processes, arranging the tours, acting as lecturers and guides during the tours. Many

others whose names we do not have on record were involved in the visits. The cooperation that we received from the individual plants and research laboratories was far greater than our expectations. They were almost all anxious to help us to understand their work and to set up the tours in whatever way we felt best. We estimate that the amount of time spent by their personnel on planning and executing the tours would be worth about $500 to $1000 for each tour for a total of perhaps $6000 that can be considered as a donation to the summer institute by the plants and laboratories.

Also consulted in arranging the tours were officials of the American Chemical Society, the Manufacturing Chemists Association, and the National Science Foundation. The New Hampshire State Department of Education, Science Consultant, Mr. Howard Wagner was also called on. They were all helpful in furnishing advise and suggestions both on the tours and on the supporting work in the classroom and laboratory.

Dr. Donald E. Wilson, Director of teacher Education at the University of Southern California was engaged as an outside evaluator.

Otherwise, the planning phase followed the Plan of Operation.

2. Participants

Recruiting, screening and selecting candidates for the program followed the Plan of Operation. The Educational Advisory Panel was very helpful in identifying teachers of disadvantaged students. About 75% of the participants were

from schools designated as having high percentages of disadvantaged children.

We received 102 applications for the 32 openings. There was a good variety of applicants who met our requirements. Because of our follow-up program during the school year, our recruiting was concentrated in New Hampshire and nearby states. The participants were all from New Hampshire except eight. All but three were from New England. As planned, we had 10 junior high school teachers with the rest senior high school teachers. This presented very little difficulty, since the program was more for broadening than for deepening their knowledge.

3. Staff

The five faculty members were all fully involved in the program. We were all in continual contact every day with formal faculty meetings twice a week. Before the program we had at least ten meetings as well as many phone conversations. All of the staff were present all day every day except when it was necessary to be away to plan up-coming tours. They not only made themselves available for discussions and consultations but made a distinct effort to mix with the participants during coffee breaks, at lunch, on the bus trips, during free time and even in the evenings.

4. Orientation Program

A very important factor in making the program a real success was the planned conscious effort to create an atmosphere of friendly good-fellowship in the entire group - staff and

participants. Some of the methods used were:

a. The acceptance letter and other correspondance were written to give as much information as possible before the participants arrived.

b. We asked for two photographs of each participant. One was sent with a news release to the home-town paper and the other was used to make a poster with pictures, names and schools of all of them. This was prominently on display when they arrived and helped them in associating names and faces more quickly.

c. Name tags were used for the first few weeks.

d. The staff, as mentioned above, was in close, friendly contact with the participants throughout. Before long everyone was on a first name and nickname basis. This was all done without the instructors losing control in classroom and laboratory.

e. We had our own coffee break in the morning. At lunch the group stayed together mostly and those in the dormitories were grouped in neighboring rooms, except for segregating men from women.

f. The "clam-bake" cemented relationships and the participants generously presented gifts to all of the staff.

We believe that the amiable feeling that was generated made the participants much more open to accepting our teaching.

5. Program Operation

The evaluation shows quite forcefully that the program objectives were met very successfully.

Interestingly, the responses of the participants showed some significant changes between the questionnaire adminstered at the end of the institute in August 1969 and the one given after a year of application in the classroom, in May 1970. For instance the tour of the Yankee Atomic Electric Co. generator was expected to be a very good trip. However at the end of the summer it was given the poorest rating by the participants. This was probably due to a number of factors; a long bus ride on a hot day, with a part of it over narrow hilly country roads that gave a rough ride, a poor choice of location for a picnic lunch, some disappointment at not actually being able to see inside the atomic reactor itself because of the radiation danger, and a rather late arrival back on campus. After a year of teaching the consensus was that this tour offered more opportunities for classroom application than any other.

An important technique in the institute was teaching by example. The participants felt that they learned a lot about how to design, present and supervise laboratory experiments from the methods we had used with them, and they learned how to make a field trip a real teaching method by our operation of the tours.

We would like to make some changes in the institute when we run it again.

a. The duration should be reduced to seven or six weeks, starting in early July and ending in mid-August.

b. Although no significant difference in performance was found between the high school teachers and junior high school teachers, there were differences in interest within the group. Some thought that computer programming was fun, while others had no ability in the type of reasoning needed for writing programs. Because of this, we would present a series of lectures on computers during the first two or three weeks, together with some hands-on operation of the computers. After this a choice would be allowed between more computer work or a series of lectures on chemical fundamentals for those with poorer backgrounds. This would allow more computer operation experience for those with a real interest.

c. We might also change to a homogeneous group of Junior High School Physical Science Teachers.

d. The laboratory experiments would be kept about the same, but the amount of work on laboratory reports would be reduced and more time would be spent on group discussion of laboratory results.

e. The emphasis on the post-tour discussions would be shifted to give more consideration of how the tour

could be used in teaching. This would be correlated with the more widely adopted texts that the teachers would be using.

f. The books in the reading room would be increased and the facilities improved.

g. Some of the tours would be changed.

h. Some of the guest lecturers would be eliminated to give more free time for study and consultation.

i. Two films were used to explain principles of infra red and nuclear magnetic resonance. These were very well received and more will be used.

j. Although the participants were typical students in their dislike of examinations, we feel that these will be continued both as incentives to studying and as a means of evaluating.

The follow-up program during the school year accomplished several objectives. It encouraged the teachers to find ways of applying the summer's experiences to their teaching. It gave us an opportunity to meet with principals, supervisors and guidance people to encourage their cooperation in allowing these applications. Because of these personal, individual contacts we did not hold a group meeting of the principals. It also gave us a chance to assess the more long-term impact of the program on the participants teaching. As the evaluation shows this was very favorable.

6. Evaluation

The report of an independant evaluator, Dr. Donald E. Wilson, Director of Teacher Education at the University of Southern California is enclosed.

III. CONCLUSIONS

1. Effect on Participants and their schools

These teachers returned to their classrooms with increased knowledge of chemistry as it is used in manufacturing and research, and how computers and modern laboratory instruments are applied. In most cases their impressions of chemistry had been changed from seeing it as an abstract body of facts and theories to a new idea of a human activity with endless practical applications. Their teaching has been improved, not only by their increased knowledge and changed attitudes, but by a better approach to teaching. Their lectures are made more stimulating by use of personal experience and practical applications to illustrate textbook material. Their laboratory instruction is bettered by using approaches seen at the institute and often adopting experiments from the institute. More field trips were arranged and they were conducted to provide better learning.

2. Effect on the Host Institution

At St. Anselm's College some of us are adopting laboratory methods from the institute to our regular courses. When we adopt a "January Term" calendar we plan to offer a program of tours and speakers based on the institute as a one-month January Term course.

3. Strengths and Weaknesses

The major strenth of the program was that it was an action program, with considerable variety, unified by the theme "What Chemists Do". Only about one-quarter of the time was spent sitting in a classroom. Of this time, about one-quarter was spent in discussion, another quarter involved guest lecturers and the remaining lecture time was divided among the five faculty members. Thus, the participants seldom listened to the same person for more than two hours a week in lectures. This minimized the opportunities for boredom.

Section 5 above lists several changes that we would make when we run the program again. Of these, the most important would be, first, not requiring everyone to go through the entire computer course and, second, a change of emphasis from extensive laboratory reports to group discussions of laboratory results.

4. Successes and Failures

Almost all of the participants profited greatly from the institute. Those that got the most ranged all the way from a junior high Physical Science teacher with only one course in Chemistry to a high school Chemistry teacher with a bachelor's degree in chemistry and a master's in science teaching. Their success seems to be mostly a result of motivation. They had come to the institute expecting to work, the novelty and variety in the program

and the friendly atmosphere captured and retained their interest and they found that there was plenty of material to challenge the well-prepared without discouraging the willing but poorer prepared student. There were only a very few whose performance was somewhat weak. Principal among these was one group of three men who roomed together. They seem to have been unwilling to put in an adequite amount of work. They did take part in the tours, laboratory work, discussions and lectures. Visits during the school year showed that they had profited from the institute.

5. Judgement of Participants

This is brought out fully in the evaluation. Principally, they felt that their knowledge of chemistry had been expanded especially in the area of how it is used. They have drawn on this knowledge to improve both classroom and laboratory teaching.

6. Effect of Unique Features of Program

The only parts of the program that were not unique were the instrumental experiments and the computer programming. These, alone, without the tours and related discussions and the guest lecturers, would have been a nice little program but would not have had the impact that the complete program had. The unique features were essential.

7. Final Analysis

Candidly, based on the comments of the participants, I believe that we accomplished exactly what we intended as set out in the objectives in the Plan of Operation and as briefly summarized in the Introduction of this report.

APPENDICES

A - Visiting Lecturers

B - Tours of Manufacturing and Research Facilities

C - Consultants

D - Brochure and Publicity

E - Letters to Applicants and Participants

F - Press Releases and Press Clippings

APPENDIX A

Visiting Lecturers

Mr. C.S. Aspinwall — Technical Rep., 3M Co.
"Thermographic Processes"

Dr. William Bannister — Prof. of Chem., Lowell Tech. Institute
"Catalytic Decarboxylations"

Dr. Armand Bibeau — Consultant, Sylvania Corp.
"Industrial Safety"

Mr. Robert Donohoe — Tech. Rep., Xerox Corp.
"Xerography"

Dr. Karen Ericson — Assist. Prof. of Chemitry, Clark University
"Chemistry of Insect Secretions"

Dr. Andre Lavigne — Assist. Prof. of Chem., St. Anselm's College
"Organogermanium Compounds"

Mr. William McLenahan — Design Engineer, Honeywell, Inc.
"The Engineer in Industry"

Dr. Paul McMaster — Assist. Prof. of Chemisty, College of Holy Cross
"Allergens in Ragweed"

Dr. Robert Normandin — Chairman, Radiation Control Commission, State of N.H.
"Nuclear Power"

Mr. George Oberlander — Assoc. Prof. of Chemistry, Univ. of Mass.
"Computors in Chemistry"

Dr. Robert O'Malley — Prof. of Chemistry, Boston College
"New Developments in Electrolysis"

Mr. Felix Popper — Chief Chemist, Hapshire Chem. Co.
"Chelating Agents"

Dr. Robinson Swift — Chem. Consultant, Daven Div.Thomas A. Edison,Ind.
"Thermoanalytical Methods"

Mr. Howard Wagner — Science Educ. Cons., N.H. Dept. of Education
"Industry + You = Enriched, Relevant Learning"

Dr. James Weber — Assist. Prof of Chem., University of N.H.
"Colors in Complexes"

APPENDIX B

Tours of Manufacturing and Research Facilities

The plants and laboratories visited were selected from the many available in the area, with the intention of providing the participants with a wide variety of experiences in the applications of chemistry. The tours included two chemical manufacturers, one organic, the other inorganic; the research center of a large chemical company; and five to illustrate the use of chemicals and of chemistry in a number of different industries: paper, metals, electronics, food, clothing, shelter and atomic power.

U.S. Army, Natick Laboratories, Natick, Mass.

The Army Materiel Command operates this installation to carry on research, development and testing on the many products used by the army for food, clothing, and shelter. The extensive facilities include such unusual equipment as arctic and tropic environmental chambers large enough for a group of soldiers to camp in, a large solar furnace, cobalt-60 and linear accelerator radiation sources, a laser beam radiation source and many other types of sophisticated laboratory equipment.

Nashua Corp., Nashua, N.H.

Basically this is a plant that produces items resulting from treating and printing paper. Products include waxed and printed wrappings, fiber-glass reinforced sealing tapes. Rotogravure printed inserts and

supplements for newspapers, and paper and associated chemicals for use in office copying machines. Related non-paper products include office copying machines and magnetically coated aluminum discs used in the memory storage of computers. The tour included the many production operations such as printing, coating, and laminating. The group also visited the quality control center and the new research and development building.

Yankee Atomic Electric co., Rowe, Mass.

The third trip was of special topical interest to the teachers. The production of electricity from atomic power at this plant is the same as at other plants in many areas of the country. The tour graphically illustrated the process of converting atomic energy into electrical energy, as compared with using water power or the energy of burning coal or oil. The unexpectedly many chemical aspects of this process were brought out along with the electrical and mechanical processes, and the problems of air pollution, radiation pollution and thermal pollution.

Hitchiner Mfg. Co., Milford, N.H.

On this tour, the group saw a very modern plant for the production of metal castings by the very ancient "lost wax" process known today as "investment casting". They saw the production of dies, manufacturing of molds, the spectacular pouring of molten

steel into the molds and the various finishing operations performed on the castings. In the laboratories they saw the instrumental techniques by which the composition of the alloys and the quality of the castings are controlled.

Hampshire Chemical Co., Division of Grace Co., Nashua, N.H.

This is a chemical manufacturing plant engaged in the production of EDTA, NTA and other organic compounds used as chelating agents or sequestrants. These products are used in many industries such as textiles, paper, and detergents. NTA is presently being substituted for phosphates in detergents to reduce water pollution problems. The participants viewed a complex production system which is highly automated with a central control area equipped with closed-circuit TV and electrical and mechanical devices for monitoring and controlling production processes for maximum safety and efficiency. They also saw the new research laboratories equipped with the latest apparatus for chemical research studies.

Precision Meter Division, Honeywell, Inc., Manchester, N.H.

The visit to the Honeywell plant nicely exemplified the applications of chemistry in the vast electronics industry. The products of this plant are electrical meters for civilian and military uses, including many used in aircraft, and low inertia motors for use in computers. Chemical operations that were seen included

injection molding, compression molding, and casting of plastics, finishing of metals and plastics by electroplating and by organic coatings, photoengraving of plastic plates for use in printing meter dials and the use of various adhesives and cleaning solvents. In addition, up-to-date assembly line production of electronic equipment was seen.

Ventron Corp., Danvers and Beverly, Mass.

Ventron is a chemical manufacturer of inorganic compounds. The Danvers plant is a large single product facility manufacturing sodium borohydride from such basic chemicals as metallic sodium, propane, boric acid and methyl alcohol. A smaller section uses high-pressure to produce various specialty inorganics. The Beverly plant includes many smaller production facilities for the manufacture of other metal hydrides, an area for high-vacuum production of ultra-pure metals, the Alfa Inorganics division that manufactures inorganic chemicals for research use, and research and development laboratories.

Cabot Corp., Billerica, Mass.

This is the research center of an international corporation. The company produces carbon black, titanium dioxide, silica and alumina for use in tires, paints and many other applications. The tour showed many research projects in process and featured the modern methods used. The equipment that was seen includes electron microscopes, nuclear magnetic resonance, spectrometer, emission

spectrograph, x-ray diffraction spectrometer, x-ray fluorescence spectrometer, gas chromatographs, mass spectrometers, infrared, visible and ultraviolet spectrophotometers and many others.

All of these tours included lectures, demonstrations and discussions by the scientists, engineers and technicians involved in the research and production activities.

APPENDIX C

Consultants

Natick	Hugh McCraven, Coordinator Mr. Schaller, Radiation Laboratory Dr. Robbins, Analytical Chemistry of Proteins Dr. Sousa, Laser Dr. Merritt, Chromatography
Nashua Corp.	Eben Thompson, Coordinator Henry Pack, Laboratory Director Michael Goodwin, Electrostatic Process Philip Leclere, Instrumental Analysis Mr. Gallagher, Introduction
Yankee Atomic	Louis Heider, Plant Superintendent Roland Emery, Tour Director Bruce Bouker, Chemist
Vermont Yankee	Addison Wilson, Tour Director
Hitchiner Mfg. Co.	Robert Francoeur, Quality Control Manager Roger Pilotte, Industrial Engineer Stephen Thurston, Industrial Engineer
Hampshire Chemical Co.	David Williamson, Personnel Manager Felix Popper, Chief Chemist Jack Singer, President
Honeywell	David Mason, Process Engineer Frank Butler, Production Manager William McLenahan, Design Engineer Frank Deroo, Process Engineer
Ventron Corp.	Jack Durrell, Personnell Manager Ed Winiarczyk, Senior Engineer Dr. Stewart Stafford, President, Alfa Inorganic Dr. Edward Miloni, Laboratory Director Ronald Pynn, Chief Technician Ed Myskowski, Production Chemist Ed Sullivan, Chemist
Cabot Corp.	Robert Amrein, Electron Microscopist A. P. LaGace, Laboratory Director D. J. Pearlman, Chemist John Mannicus, Computer Director